

20. Fauna of Western Australia.—II. The Phyllopoda of Western Australia. By W. J. DAKIN, D.Sc., F.L.S., F.Z.S., Professor of Biology in the University of Western Australia.

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Introduction.

The Phyllopoda of Western Australia have, up to date, been known only from one or two specimens collected in the Murchison District and examined by Sayce †; from one or two specimens worked at by Sars ‡; and from those specimens collected by the Hamburg Expedition to the South-West in 1905 §. The records are anything but extensive. Australia (as Wolf himself states in his report upon these crustacea) is a country where the conditions are particularly favourable for the presence of Phyllopoda.

Western Australia is exceptionally well suited for these animals, and they are to be found everywhere in large numbers after the rainy season has commenced. They occur in small rock-pools far inland, in swampy places with perhaps two or three inches of water lying in depressions in fields, in temporary lakes on the goldfields, and even in depressions filled with water—extended cart ruts—on frequently used country roads.

Future investigation should bring to light many more forms, for the area to be explored is indeed great. A glance at the following table will serve to indicate the species discovered up to date and also their distribution.

Out of the 33 to 35 Phyllopods known from the Australian Continent previous to this paper, only *two* of those species found on the eastern side of the island were known to occur in Western Australia. Only nine species altogether had been recorded from Western Australia, and seven of these were peculiar to the State.

I have been able to add to the list a number of new forms,

* For explanation of the Plates see p. 204.

† Sayce, Proc. Royal Soc. Victoria, New Series, vol. xv. 1902.

‡ Sars, Arch. for Math. og Naturvid. Christiania, xix.

§ Wolf, Phyllopoda: 'Die Fauna Südwest-Australiens,' Band iii. (Jena, 1910-1911).

Districts where recorded.

	West Australia.	South Australia.	New South Wales.	Victoria.	Queensland.	Tasmania.
BRANCHIPODIDÆ.						
<i>Artemisia australis</i> (Sayce) .....	.....	Coastal region. .....	.....	.....	.....	.....
" <i>westralensis</i> (Sayce)	Murchison. .....	.....	Near Sydney. .....	.....	.....	.....
" <i>proxima</i> ? (King) .....	.....	Near Lake Alexandrina. .....	.....	.....	.....	.....
<i>Parartemia zietziana</i> Sayce .....	.....	South Coast & Cent. Australia. .....	.....	Northern & Southern.	Inland area. .....	.....
<i>Branchinella australiensis</i> (Richters) " var. <i>occiden- talis</i> , nov.	Lake Violet. .....	.....	.....	.....	.....	.....
" <i>eyrensis</i> (Sayce)	Kalgoorlie.	Cent. Australia. .....	.....	.....	.....	.....
" <i>longirostris</i> (Wolf)	Boorabbin & Burracoppin. .....	.....	.....	.....	.....	.....
" <i>northamensis</i> , sp. n.	Northam. .....	.....	.....	.....	.....	.....
<i>Streptocephalus archeri</i> ? Sars .....	.....	.....	.....	.....	Rockhampton. .....	.....
TRIOPSIDÆ.						
<i>Triops (Apus) australiensis</i> (Spencer & Hall)	West Australia.	South Australia.	Inland area.	Northern area. .....	.....	.....
" <i>gracilis</i> Wolf	Kalgoorlie.	Central. .....	.....	.....	.....	.....
" <i>strenuus</i> Wolf	Tammin.	Southern part.	Inland and Coastal.	Northern & Southern. .....	.....	Tasmania.
<i>Lepidurus viridis</i> Baird .....	.....	.....	.....	.....	.....	.....
" var. <i>elongatus</i> Wolf	Broome Hill & Northam. .....	.....	.....	.....	.....	.....
" var. <i>setosus</i> Wolf .....	.....	South Australia. .....	.....	Victoria. .....	.....	.....

LIMNADIIDÆ.	
<i>Eulimnadia dahl</i> Sars	Port Darwin & Cent. Australia.
" <i>sordida</i> King	Near Botany Bay & near Sydney. N. S. W. p
" <i>rivoliensis</i> Brady	Southern area.
" <i>cygnorum</i> , sp. n.	Southern area.
" <i>feriensis</i> , sp. n. ....	.....
" <i>victoriensis</i> Sayce .....	.....
" <i>badia</i> Wolf .....	.....
<i>Paralimnadia stanleyana</i> King .....	.....
<i>Limnadiopsis birehii</i> (Baird)..... ?	Near Sydney. N. S. W.
" <i>squirei</i> ? Spencer & Hall..... }	N. S. W.
" <i>tatei</i> Spencer & Hall .....	.....
" <i>brunneus</i> Spencer & Hall .....	.....
<i>Cyzius</i> (<i>Estheria</i>) <i>peckardi</i> (Brady)	Northern & Southern areas.
" <i>ellipticus</i> (Sars) .....	.....
" <i>sarsii</i> (Sayce) .....	.....
" <i>lutraria</i> (Brady).....	.....
" <i>rigfa</i> , sp. n. ....	.....
" <i>dictyon</i> (Spencer & Hall)? .....	.....
<i>Cyctlestheria histopi</i> (Baird)	Rockhampton.
LYNCEIDÆ.	
<i>Lynceus macleayana</i> (King)	Near Sydney.
" <i>tatei</i> (Brady)	N. S. W.
" <i>eremia</i> (Spencer & Hall)	Northern & Southern. Southern area.

and, what is perhaps more interesting, to show that some of the species already known from the other States of the Commonwealth occur also in Western Australia. The Western State is, therefore, not so distinct from the other regions as the earlier investigations might lead one to believe. There are now twelve species or varieties which are known only from the West, and there is no doubt that further investigation will reveal several more new species and very probably a much wider distribution for the species already known. The new records are from specimens collected by Professor Woolnough, Mr. Alexander, and the author. Two of the species discovered by the Hamburg Expedition have been met with again.

EUPHYLLOPODA.

ANOSTRACA.

Family BRANCHIOPODIDÆ.

Genus ARTEMISIA.

ARTEMISIA WESTRALIENSIS (Sayce)*.

This species is the only *Artemia* known to occur in Western Australia. It was collected in Lake Aurean in the Murchison District in 1896, but no male specimens have as yet been obtained.

Genus BRANCHINELLA Sayce, 1903.

This genus was instituted by Sayce to receive two Branchipods which, though agreeing with *Branchipus* in very many ways, differed in the male claspers being without any accessory branch or spine, the second antennæ of the female being long and ribbon-like, and the penis of the male possessing certain peculiar characters.

Since the genus was founded, the Hamburg Expedition discovered one of the two species in Western Australia. This was previously known only from Central Australia. The expedition's collection also included a new species. Up to date no species of *Branchipus* has been met with in Australia. We have rediscovered the species of the German expedition, extended the distribution of an Eastern form, which, however, occurs here in the form of a variety, and added still another species to the list.

BRANCHINELLA AUSTRALIENSIS (Richters).

Variety *occidentalis*, nov. (Pl. I. figs. 1-5.)

The species *Branchinella australiensis*, a large and stout Branchipod, was first described by Richters † from specimens from

* [The parentheses around the names of authors placed after scientific names in this paper are used in accordance with Article 23 of the International Rules of Nomenclature (Proc. 7th Int. Cong. Boston 1907, p. 44 (1912)).—EDITOR.]

† Richters, Journ. de Muséum Godeffroy, xii., 1876.

Queensland. The description was, however, overlooked until re-discovered by Hall and Sayce. The latter found the species to be quite common near Melbourne. It occurs in Central Australia, the coastal area of Southern Australia, and in North and South Victoria.

In fact, its known distribution was pretty general, and only Western Australia seemed to be without it.

Two large Branchipods have been investigated in the course of this work, both unfortunately of the same sex. They agree in very many points with the description given by Sayce.

Description of male (fig. 1).—Body stout; trunk of equal length to tail. Branchial feet with large covering plates. The six endites are almost the same as in the figure given by Sayce*. The position of the flabellum is different, and the relative size of covering plate (proximal exite) and flabellum is considerably different. Claspers large and powerful (fig. 3), basal joint with inner surface clothed with minute teeth, the second joint longer in proportion to the first than in typical *Branchinella australiensis*. The inner surface of the clasper bears curious transverse overlapping shelves (fig. 4). These have the appearance of transverse ridges. They end abruptly along a regular line at each side. Frontal appendages invisible in specimens. First antennæ remarkably long, filiform, and about three times the length of the second antennæ (fig. 2), and quite different from those figured by Sayce for *Branchinella australiensis*. Caudal rami no longer than the last four segments of tail. Sheath of penis not notched (penes were not everted). Length inclusive of caudal rami 35 mm.

The resemblance to *Branchinella australiensis* seems to be great enough to consider this as a variety of form. The outstanding difference is in the first antennæ and the reduction of the frontal appendages.

Locality. Lake Violet (near the centre of Western Australia).

BRANCHINELLA LONGIROSTRIS (Wolf).

This characteristic form was first discovered in the course of the Hamburger Expedition, and had only been recorded this once from Australia. It has now been collected again (seven years later) from similar situations in the district where it was originally found.

Both males and females occur. The characteristic huge frontal appendage of the male cannot possibly be mistaken.

For complete diagrams see Wolf †.

Locality. Small rain-water ponds in depressions in rocks at Burracoppin. They occurred with the same companions found by the Hamburg Expedition, viz. specimens of *Eubinnadia badia*.

* Procs. R. Soc. Victoria, n. s. xv. pl. xxx.

† Wolf, Phyllopora: 'Die Fauna Südwest-Australiens,' Band iii. (Jena, 1910-1911).

BRANCHINELLA NORTHAMENSIS, sp. n. (Pl. I. figs. 6-8.)

Description of female.—No males of this species have been discovered. The female is an undoubted *Branchinella*. In general appearance and size the specimens resemble the females of *Branchinella longirostris*, and are much smaller and more delicate than *Branchinella australiensis*. The living animal is colourless and semi-transparent. Eyes very prominent. The head and limb-bearing region of the trunk are together much longer than the limbless posterior region (termed the tail by Sayce).

1st antennæ filiform and about $1\frac{1}{2}$ times the length of the second antennæ (see fig. 8).

2nd antennæ more or less ribbon-like but not flattened very much. They decrease but little in width until they terminate in a rounded end with a sharp point which is situated abruptly at the apex.

The ovisac (fig. 7) is very slender, without lateral expansions proximally, and extends posteriorly to the middle of the 4th limbless segment (tail-segment). It possesses the characteristic ridge on the ventral surface.

The caudal rami are well developed, provided with strong setæ and equal in length to the last four segments of the body (fig. 6). Length 13 mm.

This species is distinct from *Branchinella australiensis* in

- (1) General character, size, and shape.
- (2) Form of appendages.
- (3) Antennæ.

It is distinct from *Branchinella eyrensis* by

- (1) Frontal appendage.
- (2) Size and general form.
- (3) Ovisac.

It is distinct from *Branchinella longirostris* by

- (1) 2nd antennæ.
- (2) Ovisac.

BRANCHINELLA EYRENSIS (Sayce).

This species was recorded by the Hamburg Expedition from Kalgoorlie on the goldfields.

Only two specimens were obtained, and they were in bad condition. No other specimens have so far been met with. For diagnosis see Sayce.

CONCHOSTRACA.

Family LIMNADIIDÆ.

Genus EULIMNADIA.

Only one species had been found hitherto in Western Australia, and that by the Hamburg Expedition in 1905. This was recognised as a new species by Wolf, so that up to the date of

the present report, none of the *Eulimnadia* occurring elsewhere in Australia had been found in the West.

We have rediscovered Wolf's species and can confirm his description of the same.

In addition, we have two new species and the first record of an Eastern form.

EULIMNADIA CYGNORUM, sp. n. (Pl. I. figs. 9-13.)

Shell compressed, thin, without trace of umbones (fig. 11).

Lines of growth with great difficulty discernible and only about three visible.

Dorsal line evenly arched, with highest point anterior to middle. General shape more resembling *Eulimnadia rivolensis*, but with a more obtuse posterior end.

Head with rostral expansion in male, moderately long and bluntly pointed. In female much shorter and not acute (figs. 9 & 11).

Legs—not possible to make out exact number, but apparently not exceeding 18 pairs in female.

Male with anterior legs subchelate—developed as claspers (fig. 13). The hooked termination, which is covered with small pits, carries a prominent stalked disc. The subapical appendage is extremely long in this species, much longer than in either *Eulimnadia badia* Wolf or *Eulimnadia rivolensis* Brady. There are two distinct segments, but it is possible that the last extremely long one is in reality two, as in *Eulimnadia rivolensis*. In any case the segmentation is very much less marked than in this latter species, specimens of which have been carefully compared with it. The appendage is longer than in any other Australian *Eulimnadia*. There is an angular prominence above the terminal hook, just as in *Eulimnadia badia* and *Eulimnadia rivolensis*. Whilst, however, it is not so large as in the former species, it stands away from the claw much more than it does in *Eulimnadia rivolensis*.

The caudal claws (fig. 12) are slightly bent upwards, the proximal part very slightly so. The distal end is provided with a row of sawlike minute prickles. The proximal half bears a few feathered setæ.

The lateral plates of the tail are almost straight and bear about 20 acute denticles. The most posterior one is large and perfectly straight, differing in this respect from *Eulimnadia rivolensis*. All the spines are provided with minute sawlike points along the sides.

This species is characterised by

- (1) Shell and lines of growth.
- (2) Anterior legs of male.
- (3) Rostrum.
- (4) Caudal claws and tail.

Specimens, both male and female, obtained from Cannington, near the Swan River.

EULIMNADIA FERIENSIS, sp. n. (Pl. II. figs. 14-18.)

A considerable number of specimens, both of males and of females, was obtained from a little patch of flooded bushland at Northam. In the same pool occurred *Branchinella* and swarms of tadpoles.

Shell (fig. 14) very thin and pellucid. Of same appearance in both sexes. No lines of growth visible. In lateral view almost equilateral. The dorsal margin slightly vaulted, the greatest height being only a shade in front of the middle. Shell compressed.

Head (figs. 15 & 16). No great difference between the sexes. Rostrum short and bluntly rounded.

Legs 16-18 pairs. Anterior pairs in males subchelate (fig. 18); not particularly robust. Armed with numerous setæ. No process on inner side of band above thumblike projection (cf. figure of *Eulimnadia cygnorum*).

Tail with caudal claws (fig. 17). The proximal part of the claws bears a few feathered setæ. The region, not quite half of the total length, bears a well-marked sawlike row of minute spines. The two lateral plates terminate in two long processes, armed with minute denticles, and the upper edges of the plates in the female bear about 16 to 18 spines of unequal length. In the female there is also a tendency for the most posterior of the spines to be arranged in groups of 4 or 5, the size of spines in each group diminishing anteriorly (fig. 17). There are only about 12-14 spines in the male. All the spines are armed with minute denticles.

Size. Length of specimens 5.5 mm.

EULIMNADIA RIVOLENSIS Brady.

This species was described originally by Brady in 1886. Up to this present report it was known from Southern Australia, Central Australia, and Southern Victoria, with the possibility of an extension into New South Wales. Now it has been found in Western Australia, and not where it might have been expected, inland on the goldfields, but down on the South-West Coast in small ponds near Busselton. Several specimens were obtained there by Mr. Alexander, and the collection includes both males and females. There is nothing further to add to the descriptions previously given by Brady, Spencer and Hall,* and Sayce. This was the only *Eulimnadia* obtained by the expedition to Central Australia. This discovery of its occurrence in Western Australia is particularly interesting, because it is the first *Eulimnadia* of the East and Central States to be recorded from the West.

* Spencer and Hall, Reports Horn Expedition to Central Australia, Part II.

EULIMNADIA BADIA Wolf.

This species was the only *Eulimnadia* known from Western Australia before this report. It was discovered by the Hamburg Expedition in pools together with *Branchinella longirostris*. As mentioned in discussing that species, *Eulimnadia badia* has again turned up with its fellow companion. I can confirm the description of Wolf, but must make a slight alteration, or rather an addition, to his diagnosis of the species. The specimens were collected by Professor Woolnough. They are the largest and most robust of our *Eulimnadia*. Fortunately I have been able to compare these specimens with the type in the Hamburg Collection. Wolf remarks that never more than five lines of growth can be observed on the shells. I have recognised six and even seven on some specimens. Another slight point of difference is that the shell-gland is stated to occur always inside the first line of growth. This is frequently the case but not always, and often extends over the first line. In Wolf's drawing it is indicated well inside the lines of growth. One other point is that the head in the region of the eye does not protrude in such an angular manner as figured and described by Wolf. There is absolutely no doubt about the identity of the two sets of specimens. The characteristic features are all obvious, and it is well to emphasise these slight variations perhaps due to age or the season, especially since they have been touched upon and figured as of some little diagnostic value.

Both males and females occurred in rock-pools near Burracoppin, not very far from Boorabbin, where originally discovered.

Genus CYZICUS.

CYZICUS (ESTHERIA) RUFa, sp. n. (Pl. II. figs. 19-21.)

Five species have been recorded from Australia, and out of this number two were from Western Australia. These were determined by G. O. Sars and Sayce respectively. No specimens were met with by the German Expedition. The species of Sars is *Cyzicus elliptica*, and that of Sayce *Cyzicus sarsii*.

The new species, *Cyzicus rufa*, was collected in pools at Lakeside, Boulder City, by Mr. Alexander. Two individuals were at my disposal, but unfortunately both were females.

Characters. Shell, seen laterally, of a rather quadrangular form (fig. 19), both ends being rather too obtusely rounded to give the impression of an ellipse. Anterior-posterior length rather great for the dorso-ventral depth, and much longer than that of any of the other Australian species. Umbone prominent and situated much nearer the anterior end (about one-fourth the total antero-posterior diameter from the anterior end of the shell). The ventral margin of the shell is almost straight for some distance. Both ends are evenly rounded, and the axis of greatest length lies midway between the dorsal and ventral margins of the shell. Lines of growth about fourteen, with setæ. The sculpture of the

shell is reticulate and irregular. The valves are red-brown in colour and of firm consistency.

Rostrum (fig. 21) pointed and moderately long.

The number of legs is less than 20 pairs.

Tail of usual shape (fig. 20). The caudal plates have their upper margins almost straight. Each plate bears about five equal denticles and some smaller ones.

The caudal claws bear feathered setæ on the proximal half.

Eggs spherical.

Size. Length of adult female, 8.5 mm.

The species *Cyzicus rufa* differs from *Cyzicus lutraria* in

- (1) Shape of shell—straight ventral margin, convexity of anterior end. No compression behind middle.
- (2) Caudal plates not concave dorsally.
- (3) Rostrum of female moderately long.
- (4) Much smaller number of appendages.

The species differs from *Cyzicus elliptica* in

- (1) Shell—ridges and shape generally.
- (2) Tail.
- (3) Size.
- (4) Number of appendages.

The species differs from *Cyzicus sarsii* in

- (1) Shape of head.
- (2) Shape of shell and number of ridges.
- (3) Caudal plates.

The species differs from *Cyzicus packardi* in

- (1) Shell—general shape and lines of growth.
- (2) Shell sculpture.
- (3) Caudal plates.

Cyzicus dictyon (Spencer & Hall) seems to be synonymous with *Estheria lutraria*.

There is a possibility that this might be the female of *Cyzicus sarsii*, a species founded by Sayce on one example, a male. The differences in the shell, etc., are so great that the author considers it more probably a new species.

Family LYNCEIDÆ.

Genus LYNCEUS.

Three species of the genus *Lynceus* have been recorded from Australia, and of these none is supposed to occur in Western Australia.

The record that I have to note therefore shows still further that the supposed absence of East Australian species of Phyllopoda

from the Western State is probably due to the small number of collections that have been made.

LYNCEUS TATEI (Brady).

Several specimens were collected in pools at Busselton, South-West Australia. They agree in almost all respects with the description by Sars and the figures by Brady.

There is a slight difference in the shape of the rostrum, but this is so small that it seems hardly sound to make a new variety out of the specimens at my disposal. The collection included both males and females. The size was much smaller than the figure given by Sayce. Specimens varied between 2.5 mm. and 3.75 mm.

Lynceus tatei is now known from Victoria, New South Wales, South Australia, and Western Australia.

Family TRIOPSIDÆ (APODIDÆ).

Genera APUS and LEPIDURUS.

The family Triopsidæ contains but two genera, *Apus* (*Triops*) and *Lepidurus*. Both genera occur in Australia, and as a result of the Hamburg Expedition both were recorded from Western Australia. *Apus* itself has been recorded previously from Western Australia. Both genera appear to be pretty common in pools scattered about the State, and although specimens have only been obtained from one or two places, there is evidence that their occurrence is by no means restricted to these spots.

Genus LEPIDURUS.

Wolf, in his paper on the Phyllopoda of the Hamburg Expedition, remarks on the great difficulty in diagnosing species of this genus. The number of the segments which bear no appendages varies in one and the same species, and in no form is the number eight exceeded. Large numbers of specimens are required before one can feel certain of any systematic work. The result is that five species recorded from Australia are considered to be all identical—the species being then *Lepidurus viridis* Baird. Wolf found, however, that there were some essential differences in the specimens from different localities, which he had received for examination, and as a consequence divided his examples into two new varieties. These are *Lepidurus viridis* Baird, var. *elongatus* Wolf, and *Lepidurus viridis* Baird, var. *setosus* Wolf.

I have met with specimens which are evidently *Lepidurus viridis* var. *elongatus*, and from quite a new locality, namely Northam.

LEPIDURUS VIRIDIS Baird, var. ELONGATUS Wolf.

Specimens occur regularly every year about July and August in very shallow, muddy pools on a road at Northam.

The characteristic carapace covering all the segments of the body and only allowing a glimpse of the caudal rami enables one to recognise the similarity to Wolf's specimens.

The number of segments not bearing legs is as usual, five. The length of my specimens averaged about 28 mm. without the caudal appendages, and these brought the total length to 53 mm. This size is greater than that of the largest of Wolf's specimens.

LEPIDURUS VIRIDIS.

A large number of specimens of *Lepidurus* has been obtained from waters at Tammin, Western Australia. These individuals are certainly not Wolf's variety *Lepidurus viridis* var. *elongatus*, and still more certainly not his variety *setosus*. They may be described as follows:—The large examples average about 20 mm. for length of carapace, with a total length of 40 mm. counting the long anal furca.

The carapace is broadly rounded in front and somewhat considerably vaulted behind, with a prominent keel down the middle line. The posterior notch in the carapace is practically semicircular.

The long axes of the eyes run at an angle to each other to meet anteriorly. The anterior and posterior margins of the crescentic eyes are of similar shape and extent.

The "Nackenorgan" projecting between the two eyes and slightly posterior is circular in shape.

It seems undesirable to name these specimens anything but the simple *Lepidurus viridis*. From the difficulty of recognising varieties it would appear that a comparative study of the genus is required. This could only be carried out successfully with a very large collection of individuals from many localities in different parts of the world.

EXPLANATION OF THE PLATES.

PLATE I.

Branchinella australiensis, var. *occidentalis*, nov.

- Fig. 1. Male specimen. $\times 1.5$.
2. Head and appendages of male. $\times 3.5$.
3. Antenna or "clasper" of male. $\times 5$.
4. Surface of antenna considerably enlarged.
5. 4th trunk-limb of male. $\times 6$.

Branchinella northamensis, sp. n.

- Fig. 6. Posterior segments and caudal rami. $\times 10$.
7. Genital segments bearing ovary. $\times 10$.
8. Head and appendages of female. $\times 8$.

Eulimnadia cygnorum.

- Fig. 9. Head of male. $\times 20$.
 10. Shell. $\times 4$.
 11. Head of female. $\times 18$.
 12. Tail and caudal claws. $\times 12$.
 13. 1st trunk-limb of male. $\times 40$.

PLATE II.

Eulimnadia feriensis, sp. n.

- Fig. 14. Shell. $\times 5$.
 15. Head of male. $\times 20$.
 16. Head of female. $\times 20$.
 17. Tail and caudal claws of fema. $\times 10$.
 18. 1st trunk-limb of male. $\times 50$.

Cyzicus (Estheria) rufa, sp. n.

- Fig. 19. Shell. $\times 3\cdot5$.
 20. Tail. $\times 10$.
 21. Head of female. $\times 20$.